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Dynamics of the COVID-19 Contagion and Mortality: Country Factors, Social Media, and Market Response Evidence From a Global Panel Analysis

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ABSTRACT This research asks how an epidemic affects human behaviour. Probably the COVID-19 contagion is the most adverse global public health, economic, social, and technological stress since the Second World War. It affects almost all countries and challenges the globalisation particularly the global supply chain. The research community struggles with the multidimensional consequences of the SARS-CoV-2 virus infections. The critical goal is to quickly implement an efficient vaccine, as the society faces a tradeoff between death exposure and the size of the economic downturn. With this paper, we search for factors affecting contagion, mortality, and the time span between the country virus inception and first death. Additionally, we analyse the development of social media and financial markets. We applied a panel data set on all of the countries across the globe from 31 December 2019 until 31 March 2020 to investigate the patterns of epidemic development. We examined 7,642 country-daily data. We constructed classification tree regression, panel, and cross-sectional regression models. Our results support the conclusion that: 1) the speed of severity and contagion is different between themselves and across continents, 2) financial markets and social media respond differently to factors affecting contagion and severity, and 3) the time span between the first contagion in the economy and first death case cannot be plausibly explained with time-invariant variables. This research supports the policymakers with robust data for the informative allocation of scarce resources.

INDEX TERMS Crisis management, economic recession, financial markets, SARS-CoV-2, social media.

I. INTRODUCTION

Tectonic shifts in society occur when unexpected events force new ideas to become a reality. This study examines the human response to the pandemic. More specifically, we focus our attention on the factors influencing the time span between the country virus's first case detection date (inception), the date of the first death (the country distance to death), and the financial market's response.

On December 31, 2019, the Wuhan Municipal Health Commission announced an outbreak of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), [1] which causes coronavirus disease 2019 (COVID-19). The virus, as of 1 April 2020, has resulted globally in 870,000 confirmed cases and more than 43,000 deaths [2]. 80% of COVID-19 infections are mild, 15% are severe and 5% are critical. The total number of cases and the total number of deaths from COVID-19 represents the Case Fatality Rate (CFR or mortality rate). The mortality rate [2] for COVID-19, based on confirmed cases to date, is estimated to be between 3-4%, while seasonal influenza is sitting below 0.1%. The CFR distribution across the ages is asymmetric, with CFR at 0% population fraction for those less than 10 years old to more than 14% for those more than 80 years old [3].

The global strategy to combat the COVID-19 is limiting the spread and reducing the stress on the healthcare system,

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frequent handwashing, and social distancing [4]. Many countries impose limitations on social interaction, including "lockdown" - prohibiting all but essential travel and suspending economic and trading activities.

The pandemic countermeasures; however, affect global economic development. Ratings [5] expect world economic activity to decline by 1.9% in 2020 on a par with the global financial crisis. In contrast to the global subprime crisis of 2008, the COVID-19 first impacts the real economy and subsequently transmits to the financial sector. The fallout in the labour market exceeds historical records. Ratings [5] expects US unemployment to peak at 10% in 2Q20 with 10 million job losses. The monetary and fiscal policies respond on an extraordinary scale. Central banks' balance sheets are expanding to provide liquidity to the market. Fiscal stimulus packages have been announced in many countries worth 10% of GDP in the US and about 5% in Germany and the UK.

COVID-19 pandemic asymmetrically affects industries. Some suffer from restriction leisure and transport events while others flourish, such as parcel delivery, respirator industry, personal protective equipment industry, and home entertainment to name a few. In general, however, nationwide lockdowns reduce daily activity by about 20% from normal levels [5].

The policymakers face a dramatic tradeoff between the deterioration of welfare and human life protection. Physicians in many places face lifetime decisions on the allocation of scarce respirators among the increasing number of people in need. There is a growing demand for robust data that might support them with informed decisions. This paper responds to those needs.

We gathered the dataset which combines the pandemic, economic, financial, and social media data to uncover the factors influencing the stock market reaction and distance to death. Our dataset consists of 7,642 country-daily data for the period between 31 December 2019 and 31 of March 2020 (the "cutoff date"). With the application of the data visualisation and regression analysis, both panel and cross-sectional settings, we gathered evidence on the factors affecting country-wide pandemic and financial shock development. Our results are robust in different dimensions. The Figure 1 presents the overview of the applied framework.

II. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

The impact of coronavirus on society is the subject of numerous studies. Table 1 presents the distribution of the papers with keyword COVID across disciplines recorded in Web of Science (WoS) as of the cutoff date.

Our study contributes to a current set of COVID-19 evidence in numerous ways. Firstly, we show that uncontrolled COVID-19 is a major global death risk factor. Secondly, we show that cogitation and severity do not respond equally to different pandemic factors. Distance to death and the number of days since inception are good discriminator factors. Thirdly, the social media response is substantially driven

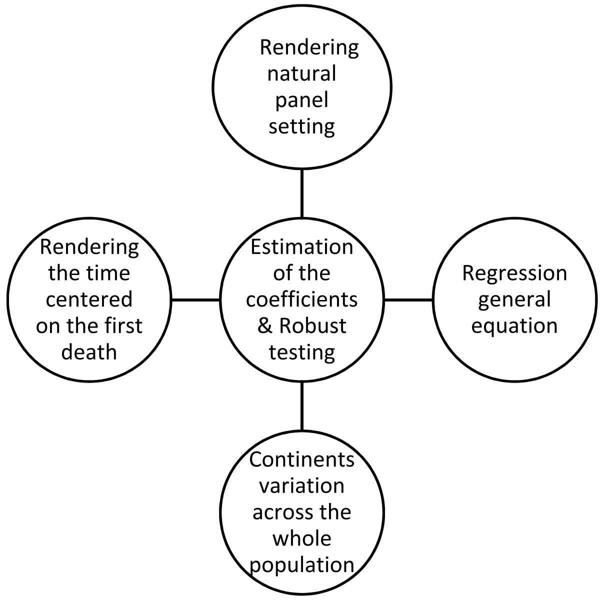


FIGURE 1. Overview of the applied framework.

by geographical factors (continents), contrary to the financial market's response. Fourthly, distance to death cannot be explained with the time-invariant characteristic of a given country. Finally, we applied the panel specification with the relative days set up, which allows capturing simultaneously the start of the cross-country death impact irrespective of the actual time.

The rest of the paper, we organise to streamline the flow of the evidence. Section two shows the current literature discussion and develops the working hypotheses. Section three provides methodological and dataset details. In section four, we present the graphical evolution of the entire dataset both in a timeline while being centred at specific countries' inceptions. In section five we report results and robustness tests, while sections six discuss and summarise the findings.

III. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

The impact of coronavirus on society is the subject of numerous studies. Table 1 presents the distribution of the papers with keyword COVID across disciplines recorded in Web of Science (WoS) as of the cutoff date.

Out of 225[1] items, 29% are papers and the remaining output represents editorial, reviews, letters, and correction. Geographically the discussion on China, the US, the UK, Singapore, Italy, Canada, Germany, Australia, Japan, Switzerland, and South Korea represents nearly 97% of the discussion. The majority of the research relates to general medicine and biochemistry, while multidisciplinary research represents less than 4%.

[1]The search was conducted at the beginning of April 2020. The WoS is updated continuously, thus the results reported in Table 1 are subject to daily changes.

TABLE 1. Keyword: Covid – Distribution of Monitored Items in WoS.

Web of Science Categories	Item	% of 255
MEDICINE GENERAL INTERNAL	93	36.471
MEDICINE RESEARCH EXPERIMENTAL	18	7.059
INFECTIOUS DISEASES	16	6.275
CELL BIOLOGY	12	4.706
CRITICAL CARE MEDICINE	11	4.314
RADIOLOGY NUCLEAR MEDICINE MEDICAL IMAGING	11	4.314
BIOCHEMISTRY MOLECULAR BIOLOGY	10	3.922
PEDIATRICS	10	3.922
PUBLIC ENVIRONMENTAL OCCUPATIONAL HEALTH	10	3.922
MULTIDISCIPLINARY SCIENCES	9	3.529
IMMUNOLOGY	8	3.137
VIROLOGY	8	3.137
ANESTHESIOLOGY	7	2.745
ONCOLOGY	7	2.745
BIOLOGY	6	2.353
OPHTHALMOLOGY	6	2.353
PHARMACOLOGY PHARMACY	5	1.961
CHEMISTRY MULTIDISCIPLINARY	4	1.569
ENGINEERING CHEMICAL	4	1.569
MATHEMATICAL COMPUTATIONAL BIOLOGY	4	1.569
MICROBIOLOGY	4	1.569
NEUROSCIENCES	4	1.569
BIOCHEMICAL RESEARCH METHODS	3	1.176
BIOTECHNOLOGY APPLIED MICROBIOLOGY	3	1.176
DERMATOLOGY	3	1.176
HEMATOLOGY	3	1.176
OBSTETRICS GYNECOLOGY	3	1.176
PSYCHOLOGY BIOLOGICAL	3	1.176
PSYCHOLOGY EXPERIMENTAL	3	1.176
RESPIRATORY SYSTEM	3	1.176
CARDIAC CARDIOVASCULAR SYSTEMS	2	0.784
EMERGENCY MEDICINE	2	0.784
GERIATRICS GERONTOLOGY	2	0.784
TRANSPLANTATION	2	0.784
TROPICAL MEDICINE	2	0.784
BIOPHYSICS	1	0.392
BUSINESS FINANCE	1	0.392
CLINICAL NEUROLOGY	1	0.392
DENTISTRY ORAL SURGERY MEDICINE	1	0.392
ECOLOGY	1	0.392
EDUCATION SCIENTIFIC DISCIPLINES	1	0.392
ENDOCRINOLOGY METABOLISM	1	0.392
ENERGY FUELS	1	0.392
ENGINEERING PETROLEUM	1	0.392
ENVIRONMENTAL STUDIES	1	0.392
EVOLUTIONARY BIOLOGY	1	0.392
GEOGRAPHY	1	0.392
HEALTH CARE SCIENCES SERVICES	1	0.392
HOSPITALITY LEISURE SPORT TOURISM	1	0.392
INTEGRATIVE COMPLEMENTARY MEDICINE	1	0.392
MATERIALS SCIENCE MULTIDISCIPLINARY	1	0.392
NANOSCIENCE NANOTECHNOLOGY	1	0.392
NURSING	1	0.392
PSYCHIATRY	1	0.392
SPORT SCIENCES	1	0.392
SURGERY	1	0.392
VETERINARY SCIENCES	1	0.392
Total	225	100%

The discussion within general medicine goes in different directions, namely: search for vaccines [6], disease clinical characteristics [7], [8], treatment [6], [9], [10], virus transmission mechanism [11], [16], efficiency testing, screening and COVID-19 detection [17], [18], public health emergency procedures and strategy [1], [19], [20], and mortality rate [21] to name a few of the research avenues.

Besides the core medical discussion, there is evidence of the broad consequences of social behavioural changes. Betsch [22] points out that the massive and rapid social behaviour change is conditional upon an individual's risk perception. Chater [23] shows the human mental reaction to extreme uncertainty and shows the tendency for the oversimplification of the complex mental problems. Strzelecki [24] suggests the role of information demand.

Researchers [25], [26] examine universities' response to COVID-19 risk. The research community responds with quality both in terms of the research agenda and lecturing techniques. COVID-19 forced rapid changes in distance learning. Many countries forced the entire education system into distance learning. For example, in Poland, the first case of COVID-19 was recorded on 3 March 2020, while the country-wide obligation to apply distance learning was enforced on 25 March 2020. Indeed, observers [27] claim that the "pandemic has forced a global experiment that could highlight the differences between and the cost-benefit trade-off of, the suite of services offered by a residential university and the ultra-low-cost education of an online education provider." The costs of the campus building and facilities will be contrasts with the face-to-face social experience.

The virus strikes, besides teaching and lecturing, other dimensions of human activities. Xiao [28] shows the impact of quarantine for COVID-19 on the possibility of psychological and mental problems.

The long-term consequence of the infection attracts systematic discussion. Catton [29] points out the shortage of qualified support staff. Chatterjee [30] indicates the global supply chain distortion in terms of generic drugs, while Wang *et al.* [1] report the need for strategic supply management, e.g. protective equipment: masks and medical protective clothing. van Staden [31] identifies an unbalance of human-animal interactions. To keep a global economy running the governments tend to monetise the ecosystems as national assets.

The common characteristics of the now available research are the limited time span of the pandemic window. There are likely more problems to be analysed. The current discussion lacks the overall picture of the economic consequences for the global pandemic. We might expect a broader discussion on fiscal financing [32], health system financing [33], public administration reorganisation [34], the sharing economy, changes in tourist preferences [35], alternative costs of the globalization of the supply chain distortion, chemical industry concentration [36], microeconomic asymmetric shocks to different industry branches e.g. leisure versus respirator manufacturing industry, rapid digitisation of services, and reshaping of innovative work behaviour [37], particularly high school education. The accounting assumption is that the going concern will face a wave of bankruptcy and insolvency outbreaks [38], [39]. The macroeconomy will struggle with the efficiency of the monetary and fiscal measures in a low-interest rate and high budget deficit environment. The pandemic set up a test environment for assessing the prior anti-systematic preclusion (e.g. financial institution concentration [40]) that we may face global stagflation. The rapid change of the unemployment dynamics across the world and worker migration in Europe will question the fundamentals of the European Union freedom of the labour force, services, and capital flow. COVID-19 is likely to contrast the globalisation costs and profits, accelerate the virtualisation of the economy, distance working, stimulate production on demand, etc.

Currently, we lack the robust evidences of those aspects of the global economy. The available now information relates mainly to the pandemic statistics and the development of the financial markets, thus with this research, we aim to utilise that data to outline the economic aspects of the pandemic. At first, we investigate whether the cross-continental pandemic dynamic is uniform. Thus, we hypothesise that:

H_{01}: *The speed of severity is uniform across continents*.

Subsequently, considering the stock of information available up to now, we test the reaction acceleration both of the pandemic spread and its severity across the countries on different potential causal factors. To capture a wide as possible a picture, we put aside the market and social media, which results in the following hypothesis:

H_{02}: *The speed of contagion and severity is driven by the same set of factors*.

We advance Strzelecki [24] observations on the mass media role with the observation that the development of financial markets is a relatively good indicator for macroeconomic development. Thus, we tested social media and market response on pandemic development, which led to the following working hypothesis:

H_{03}: *Financial markets and social media responses are driven by the same set of factors as contagion and severity*.

As the dynamic of severity might be conditional upon the static initial economy condition, thus, we investigate the factors affecting the time span between the first instance (the ‘‘inception’’) of the COVID-19 disease in a given economy and the first death (the ‘‘distance to death’’). We hypothesise that:

H_{04}: *The distance to death is conditional upon the time-invariant country characteristics.*

Suppose we can accept or reject the research hypothesis; thus, it would support the policymakers with the robust evidences of the global economic response.

IV. DATASET AND METHODOLOGY

A. DATASET

Our dataset is a combination of the data from four main sources: the pandemic statistics data from the EU Open Data Portal (EUODP), the country statistics from the World Bank Open Data (WBOD), the market data from Stooq, while the information on social media is instrumented with Internet inquiries from Google Trends (GT). The observation window starts with the Wuhan Municipal Health Commission announcement of an outbreak of coronavirus on 31 December 2019 and the cutoff date for the research is the end of 2020 first quarter. Table 2 presents the data frequency and the data source.

TABLE 2. Data sources and frequency.

#	Data	Time Span	Source
(1)	EUODP	Daily data from 31 December 2019 to 31 March 2020	https://data.europa.eu/euodp/en/data/dataset/covid-19-coronavirus-data
(2)	WBOD	Most recent annual data	https://data.worldbank.org/
(3)	Stooq	Daily data from 31 December 2019 to 31 March 2020	https://stooq.pl/
(4)	GT	Weekly data from Google Trends	https://trends.google.com/trends/?geo=US

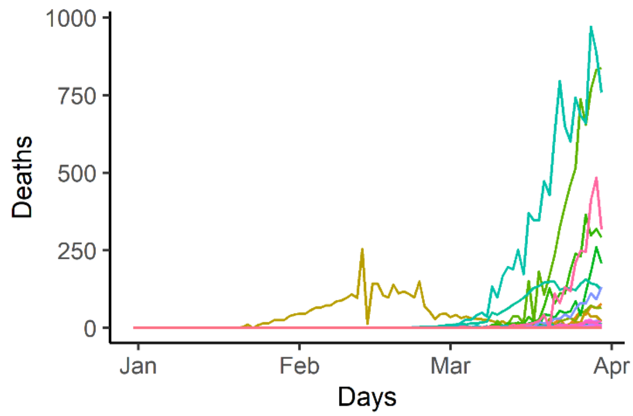


FIGURE 2. Dynamic of the number of deaths by country. Appendix 1. presents the graphical legend to the figure.

The GT observation has been input into daily data with the application of the nearest known mean values. The data from an unbalanced panel, by countries and actual days, as well as from the date since inception (the relative day setup). For the research, we applied the panel specification with the relative days set up. (compare Figure 2 and 3 for graphical insight). This strategy allows capturing simultaneously the start of the countrywide death impact of the virus irrespective of the actual time, as it was different for different countries. Appendix 1 shows the definition of the specific variables, while Appendix 2 presents its graphical legend.

B. METHODOLOGY

We start our analysis with the descriptive statistics. It follows with the graphical analysis of the data structure, regression tree classification, and country clustering on the death rate. The clustering is based on the correlations for 20 consecutive days of observation since the first death. The graphical analysis starts with a death instances presentation on a time scale and followed by the presentation on a revised scale, centred on the date of the first reported death.

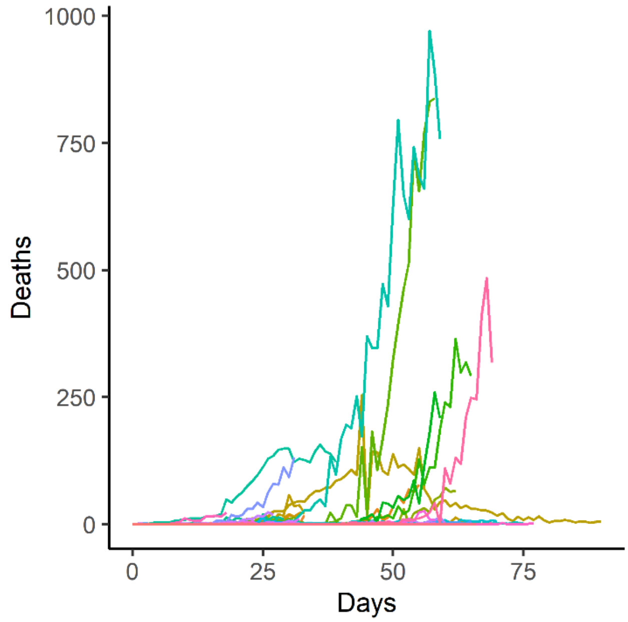


FIGURE 3. The number of deaths by country. The time scale centred on the inception day. The graphical legend to the figure is presented by appendix 1.

Our most general model of interest could be summarised in the following regression model equation:

$$\begin{aligned}\text{Dynamic}_{i,t} = {} & \beta_1 \text{Pandemic}_{i,t} + \beta_2 \text{DTD}_i + \beta_3 \text{Social media}_{i,t} \\ & + \beta_4 \text{Financial market}_{i,t} + \beta_5 \text{Country Controls}_i \\ & + \beta_6 \text{Continent Controls}_i + u_i + \varepsilon_{i,t} \qquad (1)\end{aligned}$$

For the Dynamics dependent variable, we applied the Case rate to illustrate the contagion speed and the Death rate to account for the severity. The Pandemic class of variables includes cumulative cases and death ratios, the number of days since inception, and the number of days since the first reporting day. The dynamic is controlled by the specific country's distance to death (DTD), which is a time-invariant control.

The Social media variable captures society's awareness of the development of the contagion. The instrument for the Social media is the "COVID" term index reported by Google Trends for specific countries. The index has been input from the weekly observation into daily data by application of the mean values of the nearby observation. The Country Controls variable characteristics include: age dependency, number of physicians and nurses per 1,000 of population, the fraction of the population with the handwashing facilities, the fraction of the population above 65 years of age, disaster occurrence, the density of the population, the level of the pollution, the number of the available hospital beds per 1,000 of the population, and are controlled by population and Gross Domestic Product size. The entire system is controlled by the Continents. There was no censoring of the observations as we cannot formulate a reasonable argument to claim the errors in observation or data inconsistency; therefore, as well, we rely on the unbalanced panel data.

The u_i reflects the country's individual effect and $\varepsilon_{i,t}$ is the error term. The time index was centred on the first day of the inception of the given economies, where the values thereafter were counted with positive integers, while the days of observation with negative integers represent the observations before inceptions. The $t = 0$ denotes the day of the inception (the first case reported) of the economy. We applied the random effects instead of the fixed-effect model due to the

TABLE 3. Descriptive statistics.

	count	mean	sd	min	max
Google	2270	28.98117	37.71716	0	100
Market	2270	.0006294	.002138	0	.028961 7
Cases	7642	93.55692	697.6499	0	19979
Deaths	7642	4.393091	40.54783	0	971
No of days since first reporting day	7642	35.59134	27.4813	0	90
Cum. cases	7642	1172.849	7971.722	0	143025
Cum. death	7642	46.3643	402.7759	0	10781
Inception date	7642	21965.08	18.99733	21914	22002
No of days since inception	7642	1.757132	27.85377	-62	90
Days since the first death	7642	-18.11528	27.95757	-89	79
Cumulated cases ratio	7642	.171374	.5787488	0	16
Cumulated death ratio	7642	.0468253	.2135792	0	4.6
Days since the first death	7642	-18.11528	27.95757	-89	79
Cases ratio	7642	.2028358	2.452829	-1	155
Death ratio	7642	.0061405	.4426862	-1	10
Cum. cases	7642	1172.849	7971.722	0	143025
Cum. death	7642	46.3643	402.7759	0	10781
DTD	6200	23.81258	14.43902	0	61
No of days since inception	7642	1.757132	27.85377	-62	90
No of days since first reporting day	7642	35.59134	27.4813	0	90
Age Dependency	7190	53.27427	13.6268	18	111
Physicians	7424	2.42465	1.578865	0	8.2
Nurses	7315	6.001176	4.709152	.1	20.3
Hand washing	2462	63.24366	26.90132	1.19	99
Disaster	6434	.8448555	1.68455	0	9.2
Density	7488	488.6934	2132.97	0	19196
Climate	7216	.4723808	.3410565	0	2
Hospital beds	7381	3.5685	2.85803	.1	18.7
Ln Population	7633	16.25274	2.167766	6.907	21.0545
Ln GDP	7484	9.434939	1.393596	5.750	12.1321
65 age plus	7190	11.42684	6.818484	1	28
Distance from pick of trend to the market down	3345	-.6585949	5.516941	-17	9
ItPT Distance since the inception to the pick of the trend	3345	41.40149	18.39731	9	90
ItMD Inception to the market down	3345	40.7429	18.78959	9	83
Indeks	7642	23.27205	7.180816	1	46
Observations	7642				

Appendix 1 presents the definition of variables.

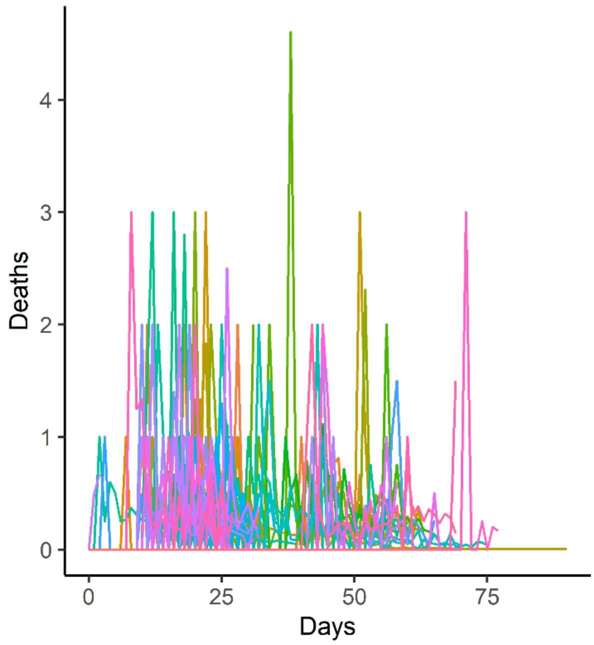


FIGURE 4. The daily ratio of cumulative deaths (CDR) by country. The time scale, centred on the inception day. The graphical legend for the figure is presented in appendix 1.

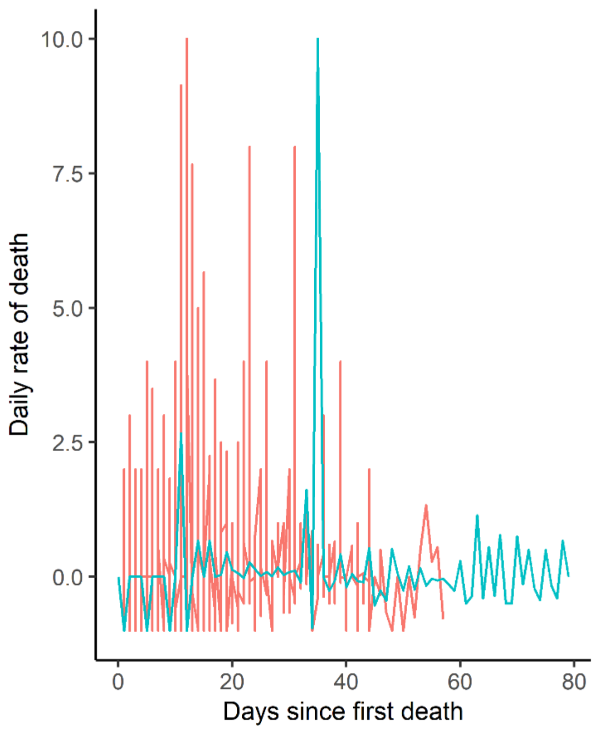


FIGURE 5. The daily rate of deaths (DRD) in China – blue line – versus the rest of the world – red line.

number of time-invariant controls. We perform the robustness test with the application of the cross-section regression as of the inception date on the DTD.

We start the analysis with the most general model of the impact of the severity and contagion of the entire available data. We individually regress the contagion and the severity. Then, at the cost of the sample size, we reverse the relation and tested the market and media response to the full set of variables. Finally, we performed a cross-section regression on the distance to death from the inception date, then evaluate the relevance of the time-invariant controls. Due to the limitation of the mean-based methodology, we verified the robustness of the results with the application of the quantile regression.

The descriptive statistics-graphical presentation was produced with an application of the R language [41], [42], while the model computation was executed in Stata [43].

TABLE 4. Global death risk factors dynamics.

	Risk factor	Cases[a)]		Cases per 1000 population[b)]	
	Year	1990	2017	1990	2017
1	High blood pressure	33268885	49546565	6.265327	6.562459
2	Smoking	27511038	34065056	5.180986	4.511928
3	High blood sugar	16553471	30881282	3.117414	4.090236
4	Air pollution (outdoor & indoor)	21954497	22673056	4.134557	3.003054
5	Obesity	10535920	22526715	1.984166	2.983671
6	Diet high in sodium	10911262	15548591	2.054852	2.059416
7	Outdoor air pollution	10154086	14826707	1.912257	1.963802
8	Diet low in whole grains	10309346	14414353	1.941496	1.909186
9	Alcohol use	8661018	13573213	1.631077	1.797777
10	Diet low in fruits	9161787	11449964	1.725384	1.516551
11	Diet low in nuts and seeds	6743386	9667358	1.269941	1.280445
12	Indoor air pollution	12546287	7532640	2.362766	0.997701
13	Diet low in vegetables	6172194	6886240	1.162372	0.912085
14	Diet low in seafood omega-3 fatty acids	4706991	6689803	0.886439	0.886067
15	Low physical activity	4078242	5983148	0.768031	0.79247
16	Secondhand smoke	5916573	5734606	1.114232	0.75955
17	Unsafe water source	9383750	5482770	1.767185	0.726195
18	Child wasting	15384563	5061947	2.897281	0.670457
19	Unsafe sex	2264770	5027739	0.42651	0.665926
20	Low birth weight	8925658	5005857	1.680915	0.663027
21	Diet low in fiber	2852039	4121768	0.537107	0.54593
22	Poor sanitation	7271639	3476151	1.369423	0.460417
23	No access to handwashing facility	5573527	3222527	1.049628	0.426825
24	Drug use	1223503	2836010	0.230415	0.37563
25	Diet low in legumes	1963959	2613480	0.36986	0.346156
26	Low bone mineral density	717375.6	1525226	0.135099	0.202017
27	Vitamin-A deficiency	4517178	1088283	0.850693	0.144143
28	Child stunting	4535457	1031874	0.854135	0.136672
29	Diet low in calcium	508957	896699.6	0.095849	0.118768
30	Non-exclusive breastfeeding	2352205	748957.7	0.442976	0.0992
31	Iron deficiency	552843.4	273463.4	0.104114	0.03622
32	Zinc deficiency	646572.5	134362.1	0.121765	0.017796
33	Diet high in red meat	64936.42	124263.6	0.012229	0.016459
34	Discontinued breastfeeding	160947.3	46977.04	0.03031	0.006222

[a)] The source data after Ritchie and Roser [44]. [b)] The dominator: 531,000 and 755,000 thousand for 1990 and 2017, respectively. Ranked from most to least frequent based on 2017 data.

V. DESCRIPTIVE STATISTICS

The descriptive statistics of our dataset are presented in Table 3.

Our financial data were matched with the GT data. The count table represents all day-country elements.

A. PANDEMIC DATA

To illustrate the pandemic development, first, we show the trajectory for death cases, speed, and cross-continent impact.

TABLE 5. **Classification of similar and adverse death dynamics for 20 days since the first reported death.**

Continent	Reference country	Like	Dislike
Asia	China	Japan, South Korea	
Asia	Taiwan	Iran	Germany
Asia	Iran		Germany
Asia	Iraq	Argentina	
Asia	Japan	Canada, South Korea	San Marino
Asia	Philippines	Argentina	
Africa	Egypt		Argentina
Europe	Germany		Taiwan, Iran
Europe	Netherlands	Spain, Switzerland	
Europe	San Marino		Iran, Japan, South Korea
Europe	Spain	Netherlands	
Europe	Switzerland	Netherlands	
Europe	UK	France	
Europe	France	Spain, UK	Iran
North America	Canada	Japan, South Korea	
South America	Argentina	Iraq, Philippines	Egypt

A mutual aspect of the contagion and severity we illustrate with the application of the multivariate methods to reduce the redundancy at descriptive analysis. Figure 2 presents the development of the death number by countries, since the Wuhan announcement.

The number of deaths varies across economies. The overall highest value in the dataset amounts to 971 cases of death reported as of 28 March 2020 in Italy, followed by Spain 838 deaths (30 March) and the US 484 (28 March). The isolated outbreak in February relates to 254 deaths reported in China, as of 13 February. The China pandemic cure is more mature in comparison to the remaining countries. The death trajectory differs among countries. Figure 3 visualises different trajectories since the COVID-19 inception date for counties. The axis of abscissa was centred with the inception moment, while the positive day counts represent the day count after inception.

The raw data presented in Figures 2 and 3 indicate the variation among countries both in terms of the inspection and the pandemic's severity. Figure 4 presents the daily cumulative deaths ratio – the relation between the number of deaths reported on a given date to the total number of deaths since the first one, less one day. The highest observed acceleration of the daily increase amounts to 4.6 for Spain as of March 10.

In contrast, Figure 5 presents the daily rate of deaths (DRD) in China versus the rest of the world, which shows a similar pattern globally. The peak of the daily increase appears around fifty days since the first death.

TABLE 6. **Random effect panel models for death ratio overall picture.**

	(1) Death ratio	(2) Cases ratio
Cases ratio	0.000244	
	(0.686)	
Cum. cases	-0.000000215	-0.0000279*
	(0.980)	(0.010)
Cum. death	0.0000414	0.0000525
	(0.679)	(0.361)
DTD	0.0323**	-0.00735
	(0.008)	(0.135)
No of days since inception	0.00194	0.00881**
	(0.638)	(0.001)
No of days since first reporting day	-0.00282	0.00386
	(0.499)	(0.381)
Age Dependency	0.0153*	-0.000149
	(0.024)	(0.977)
Physicians	-0.0156	0.163
	(0.802)	(0.202)
Nurses	0.00511	-0.203*
	(0.908)	(0.023)
Hand washing	0.00508	-0.000667
	(0.257)	(0.825)
Disaster	-0.0169	-0.0366
	(0.458)	(0.234)
Density	0.00119	-0.000374
	(0.088)	(0.289)
Climate	-0.188	0.717*
	(0.229)	(0.031)
Hospital beds	0.0248	0.0499
	(0.662)	(0.647)
Ln Population	-0.0778	0.145*
	(0.166)	(0.011)
Ln GDP	0.0641	-0.156
	(0.483)	(0.185)
65 age plus	-0.0122	-0.000910
	(0.684)	(0.967)
Africa	0	0
	(.)	(.)
Asia	0.226	0.0549
	(0.502)	(0.732)
Europe	-0.135	0.932*
	(0.597)	(0.025)
North America	0.0108	0.351
	(0.930)	(0.100)
Oceania	-0.173	0.00530
	(0.570)	(0.990)
South America	0.0985	0.293
	(0.495)	(0.210)
Constant	-0.947	-1.334
	(0.444)	(0.309)
Observations	1761	1761
N groups	75	75
R^2 within	0.00490	0.00655
R^2 between	0.462	0.0193
R^2 overall	0.00884	0.0100

Random panel regression. Standard errors adjusted for 75 clusters in the Country. Appendix 1 presents the definition of variables. *p*-values in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The speed of the virus spread and its potential severity to the global population is significant. Table 4 presents the development of the death risk factors between 1990 and 2017 both in absolute and relative figures.

TABLE 7. Random effect panels for market return and google trends.

	(1) Market	(2) Google
Cases ratio	-0.0000485***	-0.380
	(0.000)	(0.449)
Death ratio	-0.000295	-0.316
	(0.111)	(0.925)
Cum. death	-5.06e-08	0.0254**
	(0.852)	(0.003)
Cum. cases	-2.23e-08*	0.00107*
	(0.013)	(0.016)
DTD	-0.0000203	2.136*
	(0.523)	(0.039)
No of days since inception	0.00000106	1.048***
	(0.833)	(0.000)
No of days since first reporting day	0.0000171*	-0.0519
	(0.018)	(0.556)
Age Dependency	0.0000379	-5.231***
	(0.438)	(0.000)
Physicians	0.0000294	-16.56***
	(0.838)	(0.001)
Nurses	-0.000154	66.51***
	(0.744)	(0.000)
Hand washing	-0.0000122	2.076**
	(0.576)	(0.007)
Disaster	-0.0000505	16.14***
	(0.719)	(0.001)
Density	0.00000163	-0.112**
	(0.363)	(0.005)
Climate	0.00122	-345.0***
	(0.665)	(0.001)
Hospital beds	0.0000147	-52.80**
	(0.974)	(0.002)
Ln Popuplaiton	0.000327	-47.53**
	(0.457)	(0.002)
Ln GDP	0.00120	-218.1***
	(0.518)	(0.001)
65 age plus	0.000116	-15.75**
	(0.540)	(0.003)
Asia	0	0
	(.)	(.)
Europe	0.00103	-271.0**
	(0.713)	(0.008)
North America	-0.000361	70.21***
	(0.213)	(0.000)
South America	0.000622	-75.36*
	(0.434)	(0.027)

Assuming global population penetration of COVID-19 with a mortality rate at 4% (for early rate assessment comparison [21], [45]), we could expect 302 million cases

TABLE 7. *(Continued)* Random effect panels for market return and google trends.

Constant	-0.0187	3072.0***
	(0.488)	(0.001)
Observations	297	297
N_g	19	19
r2_w	0.206	0.659
r2_b	0.207	0.952
r2_o	0.222	0.724

Random panel regression. Standard errors adjusted for 19 clusters in Country. Numbers of countries limited due to availability of the stock data. Appendix 1 presents the definition of variable p-values in parentheses, * p < 0.05, ** p < 0.01, *** p < 0.001

in 2017 base, which would place the virus at the top of the global death risk factors.

Besides the variation in terms of the speed and severity of COVID-19, the market's response to local stock exchanges are different. Appendix 4 presents the classification tree results in terms of the cross continual variation of the market reaction. The market reaction was measured as the number of days between the date of inception of COVID-19 in a given economy and the number of days to the minimum value of the main local index (ItMD), during the observation window and the distance to death (DTD). The ItMD results in significant discrimination power (misclassification error rate: 0.1809).

In general, the financial markets in Europe and South America responded to the pandemic quicker than North America and Asia. The global impact of a country primarily depends on the size of the economy and the efficiency of the financial markets.

Extension of the regression tree, by society awareness of COVID-19 (ItPT), as shown in Appendix 5, results in more intensive discrimination. This suggests the impact of mass media on the pandemic development process.[2]

Table 5 shows the difference in the daily death trajectory between the countries grouped by continents. The trajectory similarities are based on the correlation for the first twenty days since the first date of reported death in the economy. The correlation below 0.5 was dropped. Appendix 4 shows the full correlation matrix for the first 20 days.

The death dynamic trajectory is homogenous within the given continent and differs across other continents.

VI. MULTIVARIATE ANALYSIS RESULTS

Table 6 shows the estimation result for the random effects model both on severity (Death ratio) and contagion (Case ratio) speed.

A relatively small variation within the group's results from the fact that the majority of the country-specific characteristics are constant over time.

We report the results of the random effect model relating to the interaction between market, social media, and daily death rates in Table 7.

[2]The classification on the country level results in dense dendrite not clearly readable, thus not reported in this study.

TABLE 8. Cross-section analysis of distance to death FROM the first day of death with the application of the OLS and Quantile regression

	(1) DTD	(2) DTD Q25	(3) DTD Q50	(4) DTD Q75
Cumulated cases ratio	-4.679	-4.796	-7.303	-2.123
	(0.199)	(0.751)	(0.746)	(0.910)
Cases ratio	0.162	1.072	0.985	0.370
	(0.878)	(0.932)	(0.947)	(0.974)
Physicians	-1.162	-1.458	-1.075	-0.687
	(0.570)	(0.938)	(0.958)	(0.963)
Age Dependency	-0.296*	-0.159	-0.251	-0.421
	(0.039)	(0.902)	(0.763)	(0.430)
Nurses	-0.0565	1.694	1.304	1.013
	(0.973)	(0.877)	(0.816)	(0.908)
Hand washing	-0.118	-0.231	-0.144	-0.124
	(0.227)	(0.626)	(0.539)	(0.608)
Disaster	0.875	0.330	0.848	0.246
	(0.328)	(0.913)	(0.644)	(0.931)
Density	-0.00819	-0.00490	-0.00664	-0.0125
	(0.259)	(0.933)	(0.930)	(0.867)
Climate	4.246	5.187	4.470	7.106
	(0.285)	(0.866)	(0.914)	(0.750)
Hospital beds	-1.594	-1.643	-2.758	-4.221
	(0.517)	(0.951)	(0.915)	(0.881)
65 age plus	1.697*	1.110	1.448	1.341
	(0.019)	(0.829)	(0.623)	(0.725)
No of days since first reporting day	0.215***	0.199	0.225	0.200
	(0.000)	(0.557)	(0.181)	(0.281)
Ln Poputlaiton	1.376	1.038	0.758	2.083
	(0.149)	(0.772)	(0.888)	(0.742)
Ln GDP	-3.805	-0.682	-2.994	-5.018
	(0.135)	(0.972)	(0.885)	(0.776)
Africa	0	0	0	0
	(.)	(.)	(.)	(.)
Asia	-5.653	1.550	-4.933	-5.439
	(0.442)	(0.913)	(0.747)	(0.660)
Europe	-3.750	2.110	-5.089	0.728
	(0.511)	(.)	(0.945)	(0.975)
North America	-3.264	2.610	-3.366	-1.565
	(0.597)	(0.880)	(0.876)	(0.942)
South America	-6.920	-3.133	-12.21	-5.272
	(0.319)	(0.872)	(0.612)	(0.753)
Constant	36.85	10.04	40.47	47.10
	(0.080)	(0.945)	(0.821)	(0.604)
Observations	41	41	41	41
R^2	0.718			
Adjusted R^2	0.487			

Appendix 1 presents the definition of variables. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Further, Table 8 presents the results of the cross-section model relating to factors affecting the distance to death (DTD).

TABLE 9. Definition of variables.

Label	Definition
Cumulated death ratio	
Google	The daily (input) value of the Google Trend scores for a given country for the keyword COVID
Market	The daily return of the main index of the main stock exchange index. The list of the indexes by country reported in the Appendix
Cases	Number of daily cases of contagion
Deaths	Number of daily deaths due to COVID-19
No of days since first reporting day	Number of days elapsing from the start of the statistic in a given country
Cum. Cases	Cumulative number of cases
Cum. Deaths	Cumulative number of deaths
No of days since inception	Number of days elapsing from the first recorded death in a given country
Days since the first death	Number of days since the first death in a country
Cumulated cases ratio	Number of cases/the cumulated number of $cases_{-1}$
Cumulated death ratio	The number of deaths/the cumulated number of $deaths_{t-1}$ (CDR)
Days since the first death	The number of days since the first reported death
Cases ratio	The ratio of the current day cases divided by the prior day cases less one
Death ratio	The ration of the current day deaths divided by the prior day deaths less one
Distance to death	The distance measured in days since the inception date and the date of the first death in each economy (DTD)
No of days since inception	The number of days elapsed since the first reported case in a given country
No of days since first reporting day	The number of days since the first reporting day in a given country.
Age Dependency	Age dependency ratio (% of working-age population)
Physicians	Physicians (per 1,000 people)
Nurses	Nurses and midwives (per 1,000 people)
Handwashing	People with basic handwashing facilities including soap and water (% of the population)
Disaster	Droughts, floods, extreme temperatures (% of the population, average 1990-2009)
Density	Population density (people per sq. km of land area)
Climate	CO2 emissions (kg per 2010 US$ of GDP)
Hospital beds	Hospital beds (per 1,000 people)
Ln Population	Natural logarithm of the total population value as of 2017
Ln GDP	Natural logarithm of the total GDP value as of 2017
65 age plus	Population ages 65 and above (% of the total population)
Distance from the peak of the trend to the market down	The time span between the date of the maximum value of Google Trends and the day of the minimum value of the country main stock index in the observation window
Distance since the inception to the peak of the trend	The time span between the date of the first case reported and the date of the maximum value of the Google Trends (ItPT)
Inception to the market down	The distance measured in days since the inception date and the date of the minimum of a market-main index (ItMD)

The base model (1) in Table 8 presents the estimation based on the ordinary least square regression with robust standard errors, while the crosscheck of the results is verified with the application of the quantile regression on 25, 50 and

TABLE 10. Country graphical codes.

ABW	BLR	CUB	FRO	HUN	KWT	MMR	PER	SRB	UKR
AFG	BLZ	CUW	GAB	IDN	LAO	MNE	PHL	SUR	URY
AGO	BMU	CYM	GBR	IMN	LBN	MNG	PNG	SVK	USA
ALB	BOL	CYP	GEO	IND	LBR	MOZ	POL	SVN	UZB
AND	BRA	CZE	GGY	IRL	LBY	MRT	PRI	SWE	VAT
ARE	BRB	DEU	GHA	IRN	LCA	MSR	PRT	SWZ	VCT
ARG	BRN	DJI	GIB	IRQ	LIE	MUS	PRY	SXM	VEN
ARM	BTN	DMA	GIN	ISL	LKA	MYS	PSE	SYC	VGB
ATG	CAF	DNK	GMB	ISR	LTU	NAM	PYF	SYR	VIR
AUS	CAN	DOM	GNB	ITA	LUX	NCL	QAT	TCA	VNM
AUT	CHE	DZA	GNQ	JAM	LVA	NER	ROU	TCD	XKX
AZE	CHL	ECU	GRC	JEY	MAR	NGA	RUS	TGO	ZAF
BEL	CHN	EGY	GRD	JOR	MCO	NIC	RWA	THA	ZMB
BEN	CIV	ERI	GRL	JPN	MDA	NLD	SAU	TLS	ZWE
BFA	CMR	ESP	GTM	KAZ	MDG	NOR	SDN	TTO	
BGD	COD	EST	GUM	KEN	MDV	NPL	SEN	TUN	
BGR	COG	ETH	GUY	KGZ	MEX	NZL	SGP	TUR	
BHR	COL	FIN	HND	KHM	MKD	OMN	SLV	TWN	
BHS	CPV	FJI	HRV	KNA	MLI	PAK	SMR	TZA	
BIH	CRI	FRA	HTI	KOR	MLT	PAN	SOM	UGA	

AFG - Afghanistan, ALB - Albania, DZA - Algeria, AND - Andorra, AGO – Angola, ATG - Antigua_and_Barbuda, ARG - Argentina, ARM - Armenia, ABW - Aruba, AUS – Australia, AUT - Austria, AZE - Azerbaijan, BHS - Bahamas, BHR - Bahrain, BGD – Bangladesh, BRB - Barbados, BLR - Belarus, BEL - Belgium, BLZ - Belize, BEN - Benin, BMU – Bermuda, BTN - Bhutan, BOL - Bolivia, BIH Bosnia_and_Herzegovina, BRA - Brazil, VGB - British_Virgin_Islands, BRN - Brunei_Darussalam, BGR - Bulgaria, BFA - Burkina_Faso, KHM – Cambodia, CMR - Cameroon, CAN - Canada, CPV - Cape_Verde, CYM - Cayman_Islands, CAF - Central_African_Republic, TCD - Chad, CHL - Chile, CHN - China, COL - Colombia, COG - Congo, CRI - Costa_Rica, CIV - Cote_dIvoire, HRV - Croatia, CUB - Cuba, CUW - Curacao, CYP – Cyprus, CZE - Czech_Republic, COD - Democratic_Republic_of_the_Congo, DNK - Denmark, DJI – Djibouti, DMA - Dominica, DOM - Dominican_Republic, ECU - Ecuador, EGY - Egypt, SLV - El_Salvador, GNQ - Equatorial_Guinea, ERI - Eritrea, EST - Estonia, SWZ - Eswatini, ETH – Ethiopia, FRO - Faroe_Islands, FJI - Fiji, FIN - Finland, FRA - France, PYF - French_Polynesia, GAB - Gabon, GMB - Gambia, GEO - Georgia, DEU - Germany, GHA - Ghana, GIB – Gibraltar, GRC - Greece, GRL - Greenland, GRD - Grenada, GUM - Guam, GTM - Guatemala, GGY – Guernsey, GIN - Guinea, GNB - Guinea_Bissau, GUY - Guyana, HTI - Haiti, VAT - Holy_See, HND - Honduras, HUN - Hungary, ISL - Iceland, IND - India, IDN - Indonesia, IRN – Iran, IRQ - Iraq, IRL - Ireland, IMN - Isle_of_Man, ISR - Israel, ITA - Italy, JAM - Jamaica, JPN - Japan, JEY - Jersey, JOR - Jordan, KAZ - Kazakhstan, KEN - Kenya, XKX – Kosovo, KWT - Kuwait, KGZ - Kyrgyzstan, LAO - Laos, LVA - Latvia, LBN - Lebanon, LBR - Liberia, LBY - Libya, LIE - Liechtenstein, LTU - Lithuania, LUX - Luxembourg, MDG - Madagascar, MYS - Malaysia, MDV - Maldives, MLI - Mali, MLT - Malta, MRT - Mauritania, MUS – Mauritius, MEX - Mexico, MDA - Moldova, MCO - Monaco, MNG - Mongolia, MNE - Montenegro, MSR – Montserrat, MAR - Morocco, MOZ - Mozambique, MMR - Myanmar, NAM - Namibia, NPL - Nepal, NLD - Netherlands, NCL - New_Caledonia, NZL - New_Zealand, NIC - Nicaragua, NER - Niger, NGA - Nigeria, MKD - North_Macedonia, NOR - Norway, OMN - Oman, PAK - Pakistan, PSE - Palestine, PAN - Panama, PNG - Papua_New_Guinea, PRY - Paraguay, PER - Peru, PHL - Philippines, POL - Poland, PRT – Portugal, PRI - Puerto_Rico, QAT - Qatar, ROU - Romania, RUS - Russia, RWA - Rwanda, KNA - Saint_Kitts_and_Nevis, LCA - Saint_Lucia, VCT - Saint_Vincent_and_the_Grenadines, SMR - San_Marino, SAU - Saudi_Arabia, SEN - Senegal, SRB - Serbia, SYC - Seychelles, SGP - Singapore, SXM - Sint_Maarten, SVK - Slovakia, SVN - Slovenia, SOM - Somalia, ZAF - South_Africa, KOR - South_Korea, ESP - Spain, LKA - Sri_Lanka, SDN - Sudan, SUR - Suriname, SWE - Sweden, CHE – Switzerland, SYR - Syria, TWN - Taiwan, THA - Thailand, TLS - Timor_Leste, TGO - Togo, TTO - Trinidad_and_Tobago, TUN - Tunisia, TUR - Turkey, TCA - Turks_and_Caicos_islands, UGA – Uganda, UKR - Ukraine, ARE - United_Arab_Emirates, GBR - United_Kingdom, TZA - United_Republic_of_Tanzania, USA - United_States_of_America, VIR - United_States_Virgin_Islands, URY – Uruguay, UZB - Uzbekistan, VEN - Venezuela, VNM - Vietnam, ZMB - Zambia, ZWE - Zimbabwe

75 quantiles. The results from (1) indicate the dependency on the age structure of the population and the number days since the first reporting. However, the robustness test does not support such a conclusion.

VII. RESULTS DISCUSSION

A. HYPOTHESIS FALSIFICATION

Our first working hypothesis *"the speed of severity is uniform across continents"* failed to hold true. Table 6 and

TABLE 11. Capital market indexes by country.

Country	Index
Argentina	MRV
Australia	AOR
Austria	A5
Belgium	BEL20
Brazil	BVP
Bulgaria	SOFIX
Canada	TSX
Chile	IPSA
China	HSI
Czech_Republic	PX
Estonia	OMXT
Finland	HEX
France	CAC
Germany	DAX
Greece	ATH
Hungary	BUX
Iceland	ICEX
India	SNX
Indonesia	JCI
Italy	FMIB
Japan	NKX
Latvia	OMXR
Lithuania	OMXV
Malaysia	KLCI
Mexico	IPC
Netherlands	AEX
New Zealand	NZ50
Norway	OSEAX
Philippines	PSEI
Poland	WIG
Portugal	PSI20
Romania	BET
Russia	RTS
Singapore	STI
Slovakia	SAX
South Korea	KOSPI
Spain	IBEX
Sweden	OMXS
Switzerland	SMI
Taiwan	TWSE
Thailand	SET
Turkey	XU100
Ukraine	UX
United Kingdom	FTM
United States of America	DJC

Appendix 4 show that the speed of the severity can be clustered based on the continents. Our classification reconciles back to the one presented by Haider *et al.* [46] based on airline traffic. The clustering itself is independent of the actual time of the pandemic outbreak. There is visible homology in COVID-19 development in Asia in contrast to Europe. It could suggest a different characteristic of the virus itself across continents or countries.

We rejected the second hypothesis *"the speed of contagion and severity is driven by the same set of factors."* In both settings. Table 6 suggests the difference in contagion speed (Case ration) versus the severity (Death ratio) in terms of the cumulative development of cases, the number of days since inception, availability of the medical support staff (Nurses), the level of the climate pollution, which heavily vary across countries. The severity is driven by the distance to death

TABLE 12. Regression tree classification based on the number of days to the minimum value of the main local index (ItMD) and the distance to death (DTD).

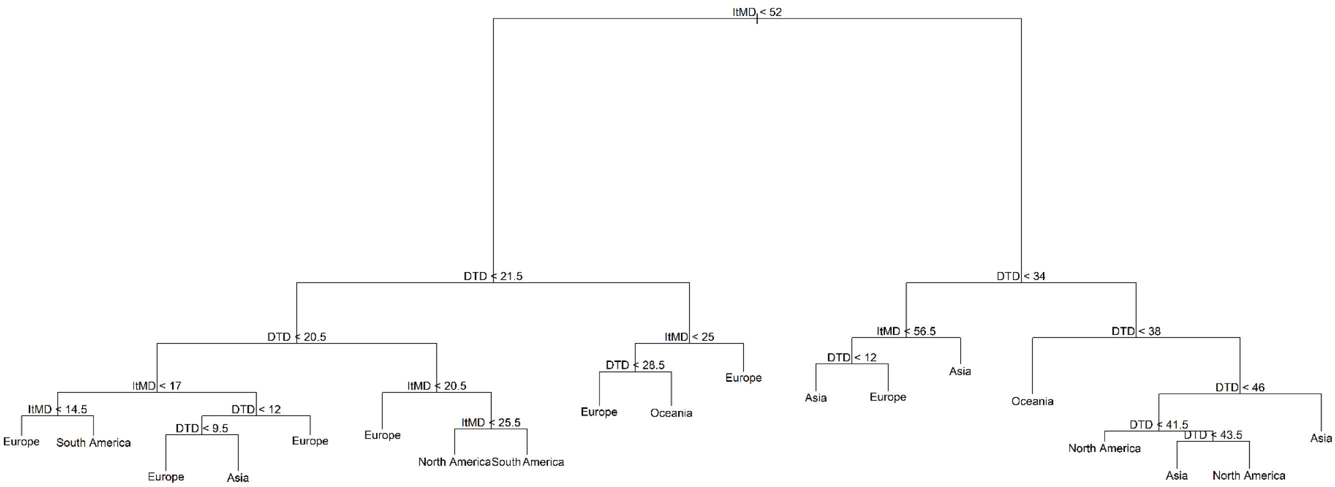
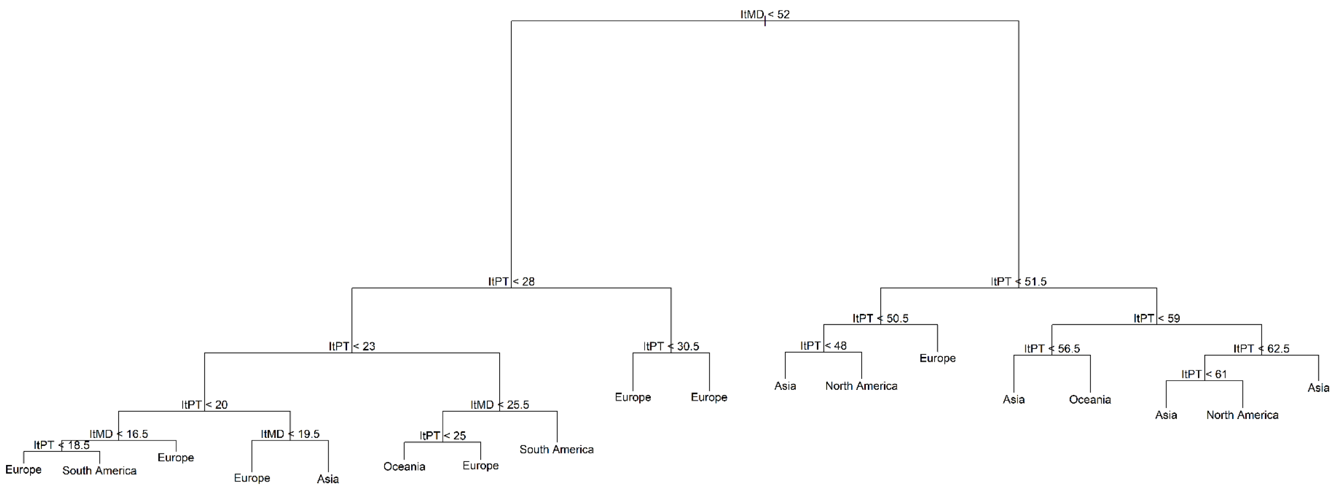


TABLE 13. Regression tree classification based on the number of days to the minimum value of the main local index (ItMD) distance since inception to the pick of the trend (ItPT).



(throughput of the health care system, age structure, and population density). The density of the population and the level of pollution are the only two factors that affect both the speed of the severity and the contagion. Nevertheless, the pandemic is characterised by the high speed of the death rate, which supports the modelling of Yang and Wang and their warning that ''we should be prepared to fight the coronavirus infection for a much longer-term than that of the current epidemic'' [47, p. 2127].

The mass media and market respond differently to pandemic development. In general, the market is more sensitive to the contagion than the severity. Social media responds to mortality and the response is conditional to the general time-invariant setting of the country. This observation extends further the prior results reported from the Chinese market by Zhou *et al.* [48]. The market and social media differences can as well be attributed to the quality of the data provided, as Kouzy *et al.* [49] indicates the different quality of the information provided by mass media (twitter). Our setting does not allow a direct conclusion thereon. Our sample was naturally limited to the economies with the available local financial market data; thus, it is a subset of the entire global population. Given this caveat, we rejected the working hypothesis that ''*Financial markets and social media response is driven by the same set of factors as contagion and severity*.''

The dynamic of the severity is not conditioned upon the static initial economy fit. The distance to death cannot be convincingly explained with the cross-sectional time-invariant characteristic. Thus, we rejected our last working hypothesis that ''*the distance to death is conditional upon time-invariant country characteristics.*''

B. COUNTRY RESPONSE TO COVID-19 STRATEGY

Chater [23] presents three interpretations of the challenges that face governments, namely: 'storm in a tea-cup' (most alarms are false alarms; most panics are overblown), 'house on fire' (lockdowns first), and 'holding back the tide' (containment of the virus is not ultimately possible; we should

TABLE 14. Dynamic of the daily death rate between the countries, which report at least 20 days since the first death.

		32	36	124	156	158	250	276	364	368	380	392	410	528	608	674	724	756	764	818	840	1100
Argentina	32	1																				
Australia	36	-0.21	1																			
Canada	124	-0.307	0.0642	1																		
China	156	-0.264	0.396	0.201	1																	
Taiwan	158	-0.0793	0.317	0.152	0.121	1																
France	250	0.35	-0.08	-0.208	-0.0895	-0.0584	1															
Germany	276	0.101	-0.222	-0.0671	-0.188	-0.972***	0.13	1														
Iran	364	0.104	0.259	-0.0404	0.245	0.490*	-0.003	-0.502*	1													
Iraq	368	0.551*	-0.209	-0.0201	0.0152	-0.198	0.216	0.194	-0.069	1												
Italy	380	0.226	-0.145	-0.138	0.224	-0.0749	0.364	0.0289	0.217	0.0174	1											
Japan	392	-0.137	-0.182	0.661**	-0.125	0.171	0.0063	-0.0818	0.0815	-0.233	-0.0277	1										
South Korea	410	-0.272	0.0101	0.554*	0.349	0.148	-0.126	-0.157	0.156	0.0505	-0.222	0.546*	1									
Netherlands	528	-0.0213	0.113	0.145	0.33	0.0917	-0.052	-0.159	-0.123	0.0273	-0.0517	-0.168	-0.053	1								
Philippines	608	0.695**	0.111	-0.194	0.0889	-0.062	0.349	0.128	0.107	0.45	0.181	-0.255	-0.178	-0.0624	1							
San Marino	674	-0.0112	-0.037	-0.393	-0.345	-0.0848	0.176	0.087	-0.483*	0.0945	-0.0229	-0.511*	-0.564*	0.0661	0.0064	1						
Spain	724	0.107	0.0551	0.0175	0.395	0.0495	0.521*	-0.052	0.123	0.0769	0.437	-0.0594	-0.194	0.598**	0.0988	0.0934	1					
Switzerland	756	0.344	-0.247	-0.212	-0.17	0.051	0.161	-0.0864	-0.107	0.184	-0.262	-0.0107	-0.126	0.519*	0.0509	-0.163	0.239	1				
Thailand	764	-0.207	0.213	-0.203	0.362	-0.0857	0.116	0.0575	0.348	-0.0433	-0.19	-0.15	0.147	-0.122	0.0344	-0.124	0.103	-0.0736	1			
Egypt	818	-0.510*	0.0141	0.237	0.0183	-0.0079	-0.125	0.0222	-0.291	-0.197	-0.1	0.0527	0.145	0.00507	-0.235	0.256	0.003	-0.383	-0.0855	1		
USA	840	-0.125	0.0722	0.373	-0.116	0.195	0.0662	-0.144	-0.0117	0.15	-0.0166	0.0208	0.0449	0.203	0.0138	0.323	0.11	-0.294	-0.448	0.419	1	
UK	1100	0.224	-0.121	-0.24	-0.46	-0.0247	0.501*	0.0638	-0.0152	0.121	0.117	-0.0822	-0.155	-0.255	0.348	0.416	-0.17	-0.148	-0.0158	0.016	0.402	1

Green positive correlations above >.5, orange negative.
* p<0.05, ** p<0.01

minimize the impact of its spread). He claims that all the isolation strategies suffer from mental strain.

In fact, the global strategy is a combination of data accumulation, prevention, and impact limitation. The mature policymaker might seek to perform the stocktaking of the healthcare system capacity, prevent the contagion speed to upgrade and facilitate the healthcare system at the cost of the economic recession, and perform social isolation, which follows with subsequently rerunning the economic process and, in parallel, limiting the severity. Our data indicate that there is not uniform cross-country timing and cost strategy, as the response both to the contagion and severity speed is driven by different factors. Nevertheless, the decision framework stays unchanged. Further research might search for the timing and cost parameters calibration or extension of classification method (for example complex network perspective [50], [51]).

C. LIMITATION

The search based on other keywords with a different abstracting database would yield different results; however, the literature direction and development picture would not necessarily be significantly affected. As of the cutoff date, information is not available for the yearly development of the pandemic, its seasonality, thus the stress test presented with Table 4 is likely to be exaggerated and represents the worst-case scenario. The classification tree shown in Appendix 4 fails to differentiate the African countries, likely due to the relatively short and flat data to the cutoff date. As of the cutoff date, the development of COVID-19 in Africa might be subject to the data underestimation, due to the relatively less-developed medicare systems and costs of the virus diagnostic. The consistency and quality of the COVID-19 data are subject to underestimation, as those who died without prior formal testing on SARS-CoV-2 virus infection might be omitted. The random-effects model allows for the inclusion of time-invariant regressors; however, threats arise when it is used. The random-effects regression requires the assumption on zero correlation between the individual effects and the regressors. The methodological framework we applied does not necessary fit for the optimization of specific country reaction to the COVID-19. The low number of countries with available data might impact the estimation of the variance of individual effects. Thus, to maintain the time-invariant regresses, we applied the crosscheck with cross-sectional regression. Our results reflect only the early phase of the pandemic development; thus, it is subject to observation window bias.

D. FURTHER RESEARCH

In addition to what is discussed in the Literature review and hypothesis development section, the crucial economic issue would be balancing society's effort against the contagion severity and deterioration of the welfare. We face a problem with the measurement of the cost-benefit between the slowdown of the economy and health care system readiness. The contrasting case studies of the Swedish and Chinese response could cast a light on specific differences.

APPENDIX 1
(See Table 9)

APPENDIX 2
(See Table 10)

APPENDIX 3
(See Table 11)

APPENDIX 4
(See Table 12)

APPENDIX 5
(See Table 13)

APPENDIX 6
(See Table 14)

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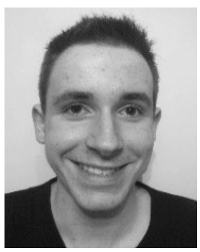

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